advancing tropical cyclones, in which the precipitation is nearly all confined to the forward half.

The foregoing description of conditions is not offered as an adequate explanation of the excessive rainfall. In this, as in many other instances of unusual rainfall, data are insufficient for a satisfactory basis of explanation. From what is known of the precipitation usually attending slight disturbances, the effects seem out of proportion to the apparent preliminary conditions. We may suggest that the angle of inclination of the ascending air in the present instance probably was relatively steep and that condensation aided in intensifying and prolonging the ascent of air, while the continued presence of the disturbance, with its wind circulation, provided the means by which the warm, moist Gulf air was fed into the precipitation machine.

Losses of cotton and other crops in overflowed fields in northern Louisiana, attending and following the heavy rains, amounted to at least a few million dollars. The Red River, which was low when the rain began, had ample channel to pass the runoff, at the rate at which it was received, without reaching bankful stage; but a number of smaller, ungaged streams overflowed.

The following is quoted from a report by Mr. J. W. Cronk, in charge of the Shreveport, La., office of the Weather Bureau:

"The drainage system in this section was so ineffectual that many thousands of acres of land were deeply covered with water for many days, with still a thousand acres or more not free from this water in lower Bossier Parish at the time of making this report, August 10. In Caddo Parish, on the right bank of Red River, where the drainage was inadequate, there were from 10 to 20 thousand acres of farm land more or less badly flooded, and in Bossier Parish, on the left bank of Red River, there were from 50 to 75 thousand acres or more also badly flooded, with some parts of the paved highways covered by water for 2 weeks. Resulting losses in this section, mainly to the nearly matured cotton crop, are estimated as being between one and two million dollars, at a low valuation."

BIBLIOGRAPHY

C. FITZHUGH TALMAN, in charge of Library

RECENT ADDITIONS

The following have been selected from among the titles of books recently received as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies:

International commission for the exploration of the upper air.
Procès-verbaux des séances de la réunion de la Commission internationale pour l'exploration de la haute atmosphère, tenue à Madrid mars 1931. 158 p. figs. plates (part fold.) 24½cm. (Sec. de l'Organ. mét. intern. No. 8.)

International geodetic and geophysical union. Section of meteorology.
Quatrième assemblée générale. Stockholm—août 1930. Procès-verbaux des séances . . . 2. Annexes. Paris. 1933. 170 p. 24½ cm.

International meteorological organization.
IIe rapport de la Commission internationale de l'année polaire 1932–33. Compte-rendu des travaux de la commission pendant sa deuxième année de travail. Procès-verbaux des séances de la réunion à Innsbruck septembre 1931. Leyde. 1932. 188 p. figs. plates (some fold.) 24½ cm. (Sec. de l'Organ. mét. internat. No. 12.)

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Instructions for making four-hourly reports. Washington. 1933. 19 p. 27 cm. (Circular, July 15, 1933.) [Manifolded.]

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SOLAR OBSERVATIONS

SOLAR RADIATION MEASUREMENTS DURING JULY 1933

By IRVING F. HAND, Assistant in Solar Radiation Investigations

For a description of instruments employed and their exposures, the reader is referred to the January 1932, REVIEW, page 26.

Table 1 shows that solar radiation intensities averaged above normal at all weather bureau stations at which normal incidence measurements are made.

Table 2 shows a deficiency in the total solar radiation received on a horizontal surface at Madison, Pittsburgh, La Jolla, Gainesville, and Miami, and an excess at all other stations.

Turbidity measurements made on the 6th show that this was an exceptionally clear day for July. Readings obtained on the following day indicate greatly increased turbidity which was the forerunner of a cloudy period that persisted until the 18th.

Polarization measurements obtained at Washington on 4 days give a mean of 57 percent with a maximum of 59 percent on the 19th. At Madison, observations obtained on 8 days give a mean of 64 percent. with a maximum of 72 percent on the 24th. The Washington values are close to the July normals, but the Madison values were slightly above normal.

TABLE 1.—*Solar radiation intensities during July 1933*

[Gram-calories per minute per square centimeter of normal surface]

Washington, D.C.

Date	Sun's zenith distance: 8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass: A.M.					P.M.				Local mean solar time
	e.	5.0	4.0	3.0	2.0	[1] 1.0	2.0	3.0	4.0	5.0	e.
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
July 5	10.59		0.87								10.59
July 6	10.97	0.70	0.85	1.02	1.19	1.43	1.17				7.57
July 7	14.60	0.38	0.43	0.63	0.96	1.26	0.94				12.24
July 18	11.38				0.98	1.32					10.97
July 19	15.11			0.84	1.15	1.30					12.68
July 29	17.96					1.18					16.20
Means		(0.54)	0.72	0.83	1.07	1.30	(1.06)				
Departures		−0.05	+0.04	+0.05	+0.16	+0.10	+0.06				

Madison, Wis.

July 15	10.59					1.44					10.21
July 17	10.97		0.89	1.03	1.18	1.42					9.14
July 18	12.24				1.05	1.39					12.68
July 19	13.61		0.72	0.88	1.03						15.65
July 24	11.38		0.99		1.26	1.45					8.48
July 25	11.38		0.95	1.09	1.20	1.40					10.21
July 26	9.83					1.37					12.24
July 27	10.59		0.75	0.87	1.07	1.38					11.81
July 28	11.38	0.63	0.74	0.86	1.07	1.32					8.18
July 29	15.11	0.61	0.69	0.86	1.02						14.60
Means		(0.62)	0.82	0.93	1.11	1.40					
Departures		−0.08	+0.02	+0.01	+0.04	+0.10					

[1] Extrapolated.

TABLE 1.—*Solar radiation intensities during July 1933*—Continued

Lincoln, Nebr.

Date	Sun's zenith distance: 8a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass: A.M.					P.M.				Local mean solar time
	e.	5.0	4.0	3.0	2.0	[1] 1.9	2.0	3.0	4.0	5.0	e.
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
July 5	11.38		0.73	0.82	1.04	1.32					14.60
July 6	10.59					1.34	1.00	0.83			12.68
July 13	16.92				1.18	1.38					16.79
July 15	14.60					1.38					14.10
July 16	11.38		0.95	1.08	1.24	1.48					8.18
July 18	16.20		0.77	0.88							16.20
July 20	18.59	0.65	0.75			1.30	1.00				17.37
July 21	17.96					1.24	0.96		0.69		20.57
July 22	13.13						0.99	0.80	0.68	0.57	14.60
July 24	10.97	0.71	0.83	0.97	1.14	1.33	1.14	1.02	0.88	0.76	12.68
July 25	12.24	0.73	0.84	0.97	1.16	1.36	1.09	0.96	0.84	0.71	12.68
July 26	12.24			1.05	1.19	1.38	1.16	0.98	0.87	0.75	11.38
July 27	10.97		0.82	0.98	1.11	1.43	1.15	0.94	0.77	0.68	11.81
July 28	11.81		0.84	0.92	1.13	1.40	1.12	0.91	0.75	0.68	9.47
July 29	12.24		0.86	1.02	1.18	1.40					13.13
Means		0.70	0.82	0.97	1.15	1.36	1.07	0.92	0.78	0.69	
Departures		+0.04	+0.04	+0.07	+0.07	+0.03	±0.00	+0.03	+0.04	−0.01	

Blue Hill, Mass.

July 1	14.6			0.96	1.06						15.6
July 6	11.8				1.04		0.86				12.2
July 10	11.8				0.99						10.6
July 12	10.2						1.05	0.86			9.1
July 13	9.8			0.83	0.97	1.23	1.12	1.03	0.97	0.92	12.7
July 14	11.4					1.33	1.11	0.91	0.77	0.67	9.8
July 18	14.1						1.02				6.8
Means				0.87	1.02	1.28	1.03	0.93	0.87	0.80	

TABLE 2.—*Average daily totals of solar radiation (direct+diffuse) received on a horizontal surface*

Week beginning—	Washington	Madison	Lincoln	Chicago	New York	Fresno	Pittsburgh	Fairbanks	Twin Falls	La Jolla	Gainesville	Miami	New Orleans	Riverdale
	Gram calories per square centimeter													
1933	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
July 2	624	513	608	514	452	711	486	396	494	341	414	479	334	663
July 9	439	505	555	570	524	722	505	470	646	353	257	491	390	640
July 16	553	501	602	556	440	726	500	281	670	293	331	474	335	642
July 23	452	570	629	584	434	664	340	523	610	[1]	537	549	337	550
	Departures from weekly normals													
July 2	+116	−17	+29	+63	+19	+22	+2		−124	−71	−78	−66		
July 9	−50	−29	−20	+120	+95	+40	+10		−52	−45	−202	−49		
July 16	+76	−17	+30	+108	+20	+62	+15		+82	−134	−133	−76		
July 23	−36	+64	+80	+156	+20	+26	−141		+34		+69	−5		
	Accumulated departures on July 29													
	+6825	+3976	+2513	+9450	+7616	+5481	+336		+280	−8038	−12124	−3269		

[1] Pyrheliometer undergoing repair.

TABLE 3.—*Solar radiation measurements, and determinations of atmospheric turbidity factor, β, Washington, D.C., July 1933*

[Values in italics have been interpolated]

Date and solar hour angle	Solar altitude, h.	Air mass, m.	I_m	I_y	I_r	β	Blueness of sky	Atmospheric dust particles per cubic centimeter	Notes: (skylight polarization, P.) clouds, etc.
July 6			*gr. cal.*	*gr. cal.*	*gr. cal.*				
5:55 a	14–55	3.84	0.881	*0.652*	0.504	0.035	------	449	------
5:51 a	15–40	3.65	.899	.655	*.507*	.040	------	------	------
5:40 a	17–43	3.26	.985	.700	*.564*	.042	------	------	------
5:36 a	18–28	3.13	1.008	*.704*	.568	.040	------	------	------
5:06 a	24–05	2.44	1.071	*.772*	.596	.055	------	------	------
5:01 a	25–01	2.35	1.108	.775	*.598*	.045	6	------	P=58.4%
0:38 a	71–58	1.05	1.421	.828	*.690*	.038	------	------	------
0:33 a	72–21	1.05	1.411	*.830*	.690	.040	------	------	------
3:24 p	43–55	1.44	1.302	.830	.640	.035	------	------	------
3:28 p	43–08	1.46	1.304	.832	*.640*	.035	------	------	------
3:52 p	38–19	1.61	1.257	.754	*.630*	.040	------	------	------
3:56 p	37–42	1.63	1.226	*.756*	.628	.045	------	------	------
4:26 p	32–09	1.88	1.223	*.864*	.660	.055	------	------	------
4:36 p	31–30	1.91	1.192	.865	*.658*	.070	------	------	------
July 7									
5:56 a	14–38	3.92	.485	.284	*.220*	.065	------	905	------
5:52 a	15–27	3.72	.512	*.286*	.222	.070	------	------	------
5:34 a	18–50	3.08	.615	*.348*	.288	.065	------	------	------
5:28 a	19–58	2.92	.633	.349	*.290*	.070	------	------	------
4:49 a	27–24	2.17	.910	.550	*.460*	.072	------	------	------
4:44 a	28–21	2.10	.917	*.552*	.462	.075	5	------	P-55.7%
3:21 a	44–28	1.43	1.147	*.732*	.608	.100	------	------	------
3:16 a	45–26	1.39	1.130	.734	*.610*	.120	------	------	------
1:20 a	66–22	1.09	1.232	.823	*.650*	.090	------	------	------
:16 a	67–00	1.09	1.223	*.826*	.626	.095	------	------	------

POSITIONS AND AREAS OF SUN SPOTS

Communicated by Capt. J. F. Hellweg, Superintendent United States Naval Observatory. Data furnished by Naval Observatory, in cooperation with Harvard, Perkins, and Mount Wilson observatories. The differences of longitude are measured from central meridian, positive west. The north latitudes are plus. Areas are corrected for foreshortening and are expressed in millionths of sun's visible hemisphere. The total area, including spots and groups, is given for each day in the last column]

Positions and areas of sun spots—Continued

Date	Eastern standard civil time	Heliographic: Diff. long.	Heliographic: Longitude	Heliographic: Latitude	Area: Spot	Area: Group	Total area for each day
1933	h. m.	°	°	°			
July 1 (Naval Observatory)	10 40	No spots			------	------	------
July 2 (Naval Observatory)	14 8	No spots			------	------	------
July 3 (Mount Wilson)	9 4	No spots			------	------	------
July 4 (Naval Observatory)	10 21	No spots			------	------	------
July 5 (Naval Observatory)	11 15	No spots			------	------	------
July 6 (Naval Observatory)	10 5	−66.0	66.3	+6.0	------	31	31
July 7 (Naval Observatory)	13 24	−78.0	39.3	+6.0	------	12	------
		−53.0	64.3	+7.0	------	22	34
July 8 (Naval Observatory)	10 32	−65.0	40.6	+6.5	9	------	------
		−40.5	65.1	+7.5	------	19	28
July 9 (Mount Wilson)	8 30	−51.0	42.5	+7.0	3	------	------
		−29.0	64.5	+7.0	------	8	11
July 10 (Mount Wilson)	8 40	−15.0	65.2	+7.0	------	4	4
July 11 (Perkins Observatory)	13 30	No spots			------	------	------
July 12 (Naval Observatory)	13 46	−65.0	345.9	−4.0	------	9	------
		+14.0	64.9	+7.5	------	15	24
July 13 (Naval Observatory)	10 29	No spots			------	------	------
July 14 (Mount Wilson)	8 35	−42.0	345.2	−5.0	------	4	------
		+38.0	65.2	+5.0	------	7	11
July 15 (Mount Wilson)	8 25	+52.0	66.0	+7.0	2	------	2
July 16 (Naval Observatory)	12 56	No spots			------	------	------
July 17 (Naval Observatory)	14 48	No spots			------	------	------
July 18 (Naval Observatory)	11 24	No spots			------	------	------
July 19 (Naval Observatory)	11 3	No spots			------	------	------
July 20 (Naval Observatory)	13 36	No spots			------	------	------
July 21 (Naval Observatory)	11 32	No spots			------	------	------
July 22 (Naval Observatory)	11 35	No spots			------	------	------
July 23 (Naval Observatory)	12 34	No spots			------	------	------
July 24 (Naval Observatory)	10 45	No spots			------	------	------
July 25 (Mount Wilson)	8 38	No spots			------	------	------
July 26 (Mount Wilson)	11 20	No spots			------	------	------
July 27 (Mount Wilson)	9 6	No spots			------	------	------
July 28 (Perkins Observatory)	12 15	No spots			------	------	------
July 29 (Naval Observatory)	11 5	No spots			------	------	------
July 30 (Naval Observatory)	11 10	No spots			------	------	------
July 31 (Perkins Observatory)	14 5	No spots			------	------	------
Mean daily area for July							5

PROVISIONAL SUN-SPOT RELATIVE NUMBERS FOR JULY 1933

(Dependent alone on observations at Zurich and its station at Arosa)

[Observations furnished through the courtesy of Prof. W. Brunner, Eidgen. Sternwarte, Zurich, Switzerland]

July 1933	Relative numbers	July 1933	Relative numbers	July 1933	Relative numbers
1	0	11	8	21	0
2	0	12	7	22	0
3	0	13	0	23	0
4	0	14	0	24	0
5	0	15	0	25	0
6	*Ec* 7	16	0	26	0
7	17	17	0	27	0
8	17	18	0	28	0
9	18	19	0	29	0
10	14	20	0	30	0
				31	0

Mean: 31 days=2.8.

c=New formation of a very small center of activity; E, on the eastern part of the sun's disk.

AEROLOGICAL OBSERVATIONS

[Aerological Division, W. R. Gregg, in charge]

By L. T. Samuels

Free-air July temperatures averaged moderately above normal at the stations listed in table 1, except Norfolk, Pensacola, and San Diego, where negative departures predominated. Relative humidity departures were small to moderate and in most cases of opposite sign to those of the temperature.

Resultant free-air wind velocities in the lower levels were generally less than normal with an excess of southerly components at a number of stations east of the Rockies. (See table 2.) At the higher levels the resultants were mostly close to normal with some excess of northerly components at a few of the central stations.